New composting technology as a potential tool for valorizing agri-food wastes into compost and liquid nitrogen fertilizer

Mesfin T. Gebremikael[1]*, Dorian Medrano[1], , Hanne Lakkenborg Kristensen[1]

[1] Department of food sciences, Aarhus University, 8200 Aarhus Denmark

* mesfin.gebremikael@food.au.dk

Compost application is one of the main tools to improve soil biodiversity, maintain soil fertility and sustainable food production. Despite the benefits of composting, existing farm-level traditional composting techniques cause substantial ammonia and GHG (N_2O, CH_4) emissions, which could potentially surpass the essential benefits of composting and compost application in the long term. To reduce the environmental impact and improve farm resource efficiency, a company developed a new automated composting drum which can turn organic wastes into compost and liquid nitrogen (N) fertilizer within 7-10 days without external chemical application. While the technology has several advantages, the compost quality and its potential to improve soil fertility need to be evaluated. Given the short retention time, we hypothesized that the compost may not be completely mature and could result in net immobilization of the native N in the soil solution.

To test the hypothesis, we set up an incubation experiment with sandy soil mixed with the new compost (NewComp) and a standard windrow compost (WrComp) both made from organic vegetable wastes. Compost was applied at a rate of 20 t DM ha^{-1}, and a commercial organic fertilizer (OF) at a rate of 6.5 t DM ha^{-1} which is equivalent with the total N applied with the NewComp compost. The moisture content was adjusted to 50% water-filled pore space. Three replicates were destructively removed after 0, 7, 21, 35, 49, 70, and 91 days of incubation in a chamber at 21 ^{0}C and analyzed for mineral N and the soil microbial enzyme, dehydrogenase, activities. A phytotoxicity assay was also conducted using Cress (*Lepidium sativum*) as a test plant in a separate experiment.

The result showed that the NewComp compost has a high C:N (29.5:1) and NH_4^+:NO_3^- (34:1), indicating that the compost is still in the active decomposition stage. Furthermore, NewComp compost resulted in significantly higher net immobilization during the 90 days incubation experiment. On the other hand, the dehydrogenase activity was significantly higher (up to two-fold) in NewComp compost compared to the unamended control, WrComp and OF for 90 days showing that the compost has a substantial potential to improve the soil microbial activities. The phytotoxicity test showed that the NewComp compost could be mixed with soil up to 50% without significantly affecting germination. Further studies are needed to reduce the net N immobilization effect of the NewComp compost.

Acknowledgements

The authors are grateful to the Ministry of Food, Agriculture and Fisheries of Denmark for funding the research of the ComCrop project under GUDP and ICROFS programmes and to the Interreg North Sea Region for funding the research of the SoilCom project.